

Amendment to the Specification and Claims

The change to the specification was made to correct a clerical error that was not noticed upon proofreading the application. The solvent used for the catalyst was polyvinyl alcohol, not polyvinyl acetate. Applicant submits that the solvent used for the catalyst is not an aspect of the claimed invention and is immaterial to describing the invention. The only reason for the change was to correct a mistake.

Support for the amendments to the claims can be found in the application at page 8, lines 13-19 and page 8, line 27 to page 9, line 5.

The Invention

As the amended claims indicate, this invention relates to heat-cured furan binders comprising a furan resin, furfuryl alcohol, a dimethylated furan, polyvinyl acetate, and an activator.

What is novel and unobvious about the invention is the specific combination of components claimed and the advantages that result from this combination of binder components:

- (1) The cure speed of binder (as evidenced by lower dwell times) is much faster than the cure speed of conventional heat-cured furan binder.
- (2) The hot and cold tensile strengths of cores prepared by this invention are higher earlier on than the cores prepared with conventional heat-cured furan binders.

These advantages benefit foundries, which require high productivity, because the cores can be handled sooner without breaking and the cycle time for producing the cores is reduced.

The heat-cured binders are used to prepare molds and cores by the warm-box and hot-box process. The binders are particularly useful in warm-box applications, because they cure faster and exhibit higher tensile strengths than conventional furan warm box binders.

DISCUSSION OF EXAMINER'S OFFICE ACTION

Claim Rejections - 35 USC § 112, second paragraph

The following is a quotation of the second paragraph of 35 U.S.C. §112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter, which the Applicants regards as their invention.

Claims 9-12 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 9 recites the limitation " latent acid curing catalyst " in line 1, There is insufficient antecedent basis for this limitation in the claim.

Applicant's Response

Claim 9 was amended to overcome this rejection.

Claim Rejections - 35 USC § 103 (a)

The following is a quotation of 35 U.S.C. §103(a), which forms the basis for all obviousness rejections Office action:

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Legal Standard of Obviousness

Graham V. John Deere, 383 U.S. 1, 148 U.S.P.Q. 459 (1966) outlined the approach that must be taken when determining whether an invention is obvious. In *Graham*, the Court stated that a patent may not be obtained if the subject matter would have been obvious at the time the invention was made to a person having ordinary skill in the art, but emphasized that nonobviousness must be determined in the light of inquiry, not quality. Approached in this light, §103 permits, when followed realistically, a more practical test of patentability. In accordance with *Graham*, three inquiries must be made in determining whether an invention is obvious:

- (1) The scope and content of the prior art are to be determined.
- (2) The differences between the prior art and the claims at issue are to be ascertained.
- (3) The level of ordinary skill in the pertinent art resolved.

Against this background, the obviousness or nonobviousness of the subject matter is determined. Secondary considerations, such as commercial success, long felt but unsolved needs, failure of others, etc., can be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented.

In conjunction with the interpreting 35 U.S.C. §103 under *Graham*, the initial burden is on the Examiner to provide some suggestion of the desirability of doing what the inventor did, i.e. the Examiner must establish a *prima facie* case of obviousness. To support the conclusion that the claimed invention is directed to obvious subject matter, either the references must expressly or impliedly suggest the claimed invention, or the Examiner must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references.

To establish a *prima facie* case of obviousness, three basic criteria must be met:

1. There must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings.
2. There must be a reasonable expectation of success.
3. The prior art reference (or references when combined) must teach or suggest all the claim limitations.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on Applicants' disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q. 2d 1438 (Fed. Cir. 1991). See MPEP § 2143 - § 2143.03 for decisions pertinent to each of these criteria.

The person of ordinary skill in the art (TPOSA)

Determining the level of ordinary skill in the art is often the most difficult of the *Graham* inquiry in an *ex parte* proceeding. In an *ex parte* proceeding, the Examiner and Applicants typically do not have testimony or survey evidence on this issue. They must rely on the experience of the Examiner and Applicants to resolve this issue.

For this invention, Applicants submit that the relevant art relates to foundry binders and their use. It is assumed that TPOSA working in this field typically had a degree in chemistry or at least a working knowledge of the basic chemistry in the field of foundry binders. Applicants assume that TPOSA was aware of the references cited by the Examiner.

Applicants believe these are the circumstances that were influencing TPOSA at the time Applicants made their invention. This information, practical knowledge, and costs influenced TPOSA in solving problems. The foundry industry was a mature industry and the field was very crowded. Based upon their experience in the art, Applicants submit that technological improvements in this field were gradual and only incremental.

Claims 1-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Coss, US Patent No. 4451577 in view of Kiuchi et al., US Patent No. 5932628.

Coss discloses a foundry mixture containing a furan-based binder and polyvinyl alcohol. Exemplary furan-based binders include those binders, which are the products of furfuryl alcohol bis-hydroxymethylfuran with itself, bis-hydroxymethyl furan and/or formaldehyde.

Coss further teaches a foundry method for the rapid production of cured, high tensile strength foundry sand shapes from this foundry mixture wherein the polyvinyl alcohol is incorporated into a special thermally-activated strong acid salt catalyst prior to admixture of the catalyst composition with the sand and a furan-based binder. The sand-binder-catalyst composition is then shaped and the sand shapes are heated, resulting in exceptionally high tensile strengths

in short times. In foundry methods involving *in situ* heating of the sand shape within the pattern, clean release (without sticking) from the pattern after cure is achieved. The foundry mixture comprising foundry sand, a furan-based binder, and a catalyst composition containing a salt of a strong acid and a polyvinyl alcohol, is cured in less than five minutes¹ by heat-activating the composition.

Patentee employs catalysts in the process of the invention which include (a) salts of strong acids which are of the type of salts commonly employed in furan binder-containing hot box foundry methods, and (b) salts or pseudo-salts of certain strong organic acids. The strong acid salts which are commonly employed in furan binder containing hot box foundry methods are those salts which have sufficient latency to provide an adequate working life of the composition. See col. 2, line 46 through col. 5, line 30 and claim 1.

Patentee teaches that polyvinyl alcohol, hereinafter referred to as "PVA", is a water soluble synthetic polymer made by the alcoholysis of polyvinyl acetate. The properties of PVA depend to a large extent on the degree of polymerization and the percentage of alcoholysis, both of which are controllable by processing. **It is probable that residual polyvinyl acetate is present in the Coss compositions.**²

Kiuchi et al US Patent No. 5932628 discloses a self-curing binder composition for the production of molds comprising a binder obtained by polycondensation of furfuryl alcohol, urea, and an aldehyde, wherein the difference between the weight % of charged furfuryl alcohol (A) based on the weight of the binder and the weight % of unreacted furfuryl alcohol (B) based on the weight of the binder after the polycondensation is 5.0 to 60.0. In addition to the binder the composition may contain a curing accelerator, a silane coupling agent. The silane coupling agent is preferably added in an amount of 0.03 to 1.0% by weight in the total amount of the composition. See col. 2, line 10 through col. 10, line 49.

Since silane coupling agents are considered conventional additives in the formulation of foundry compositions as is documented by Kiuchi et al, the addition of such a coupling agent would have been obvious to one of ordinary skill in the art at the time of applicant's invention.

Applicant's Response

The Examiner mentions that Coss, the primary reference, uses "PVA" in his binder. Applicant believes this characterization of Coss is inaccurate and somewhat misleading. It is true that Coss mentions "PVA", but in Coss "PVA" refers to polyvinyl alcohol. Furthermore, in Coss, polyvinyl alcohol is used in the catalyst composition, which is a separate component that is mixed with the sand aggregate before the binder is added to the sand.³ It is not used in the binder component.

Polyvinyl alcohol is not a required component of Applicant's binder. Instead, Applicant's binder, as defined by the amended claims, contains polyvinyl acetate, which is what "PVA" refers to in Applicant's application. Coss does not teach or suggest the use of polyvinyl acetate in his binder composition. The Examiner argues that "[i]t is probable that residual polyvinyl acetate is present in the Coss compositions", but does not cite any authority for this

¹ Bolded for emphasis.

² Bolded for emphasis.

³ Column 3, lines 22-24.

claim. It is based upon his view of that some residual polyvinyl acetate remains when it is converted to polyvinyl alcohol.

Although no where does Coss suggest that the polyvinyl alcohol contains residual polyvinyl acetate, Applicant concedes that this is a possibility. But even if the catalyst of Coss does contain some residual polyvinyl acetate, Applicant submits that the residual amount would be so minor that it would not affect the tensile strengths of cores and molds made using the catalyst composition, because Coss indicates that the polyvinyl alcohol is added, as a dilute solution, to the acid catalyst.

So to get an idea of how much residual polyvinyl acetate could be in the catalyst composition, let's consider, for instance, Example 1 of Coss. In Example 1 of Coss, 26.61 parts of polyvinyl alcohol, as a 35 percent solution, was added to 61.11 parts of phenol sulfonic acid solution and 10.28 parts of urea. Thus, the amount of polyvinyl alcohol in the catalyst composition was $26.61 \times 0.35 = 9.31$ per 98 parts catalyst composition, which is equal to 0.095 part polyvinyl alcohol per part catalyst composition. Since 6 parts of catalyst composition were added to 3000 parts sand in Example 1, the amount of polyvinyl alcohol added to the sand was $6 \times .095 = 0.57$ part polyvinyl alcohol. Applicant submits that the amount of residual polyvinyl acetate, if any, in 0.57 part of polyvinyl alcohol per 3000 parts sands would not have any effect on the tensile properties of cores and molds made with the catalyst composition.

In addition to the fact that Applicant's binder, as defined by the amended claims, contains polyvinyl acetate, there is another difference between Applicant's binder and Coss. Although Coss's binder does contain a bis-hydroxymethyl furan, Coss does not teach or disclose that the binder contains dimethyolated furans.

Additionally, the binder, as defined by the amended claims, also contains an activator selected from the group consisting of resorcinol, bisphenol A tar, and mixtures thereof. Coss does not teach or suggest using an activator, as so defined, in his binder.

The secondary reference, Kuichi, does not teach or suggest the modifications needed to derive Applicant's binder, as defined by the amended claims, from Coss. First of all, Kuichi's binder is cured at room temperature rather than with heat. And Kuichi's binder does not contain polyvinyl alcohol or an activator as defined in Applicant's amended claims.

The significance of using the unique combination of components to formulate Applicant's binder is shown in the examples of Applicant's patent application at pages 13-14. A furan binder, which does not contain any dimethyolated furan is shown in Example A is compared to the binders in Examples 1-2, which contain a dimethyolated furan. The data in Table II of the application indicate that the binders of Examples 1 and 2, which contain polyvinyl acetate, resorcinol pitch, and a dimethyolated furan, produced test cores with higher hot and cold tensile strengths than the traditional warm box system (Examples A), and that using higher amounts of dimethyolated furans in the binder resulted in higher tensile strengths.

Applicant submits that the claimed invention is novel because the prior art does not teach the use of this combination of components in a heat-cured binder. Applicant further submits that the claimed invention is not obvious because TPOSA would not have reasonably expected the advantages, which result from using this combination of components in such a binder.

Conclusion

In view of the differences between Applicant's invention and the prior art, Applicant submits that claims 1-13 were not obvious to TPOSA at the time the invention was made. When considering the obviousness of this invention, whose essence is a novel combination of components, Applicants request that the Examiner consider what the Court said in *In re Kotzab*, 55 U.S.P.Q. 2d 1313 (Fed. Cir. 2000) at page 1317:

Most if not all inventions arise from a combination of old elements. See *In re Rouffet*, 149 F.3d 1350, 1357, 47 USPQ2d 1453, 1457 (Fed. Cir. 1998). Thus, every element of a claimed invention may often be found in the prior art. See *id.* However, identification in the prior art of each individual part claimed is insufficient to defeat patentability of the whole claimed invention. See *id.* Rather, to establish obviousness based on a combination of the elements disclosed in the prior art, there must be some motivation, suggestion or teaching of the desirability of making the specific combination that was made by the APP. See *In re Dance*, 160 F.3d 1339, 1343, 48 USPQ2d 1635, 1637 (Fed. Cir. 1998); *In re Gordon*, 733 F.2d 900, 902,

221 USPQ 1125, 1127 (Fed. Cir. 1984). Even when obviousness is based on a single prior art reference, there must be a showing of a suggestion or motivation to modify the teachings of that reference. See *B.F. Goodrich Co. v. Aircraft Breaking Sys. Corp.*, 72 F.3d 1577, 1582, 37 U.S.P.Q. 2d 1314, 1318 (Fed. Cir. 1996).

Applicant submits that there was no motivation in the prior art to suggest this unique combination of binder components, but even if there were, TPOSA could not have reasonably predicted the benefits, which resulted from using the binders.

Applicant submits that his invention could only be derived from the references by the use of "hindsight", i.e. by knowing what Applicant's invention was in advance from Applicant's disclosure, and then *ex post facto* reconstructing Applicant's invention from the prior art after a thorough search. The prior art does not lead TPOSA to Applicant's invention. The Examiner knew, from Applicant's own disclosure, what Applicant's invention was when the patentability search was conducted. And it is not easy to separate what the Examiner knew from the Applicant's disclosure and what the prior art suggests. By the nature of the examination, the Examiner makes his determination of obviousness *ex post facto*. TPOSA does not have the advantage of knowing what the invention is, and must derive the invention from his insight as applied to the prior art. Applicant urges the Examiner to keep this in mind when deciding whether Applicant's invention is obvious. Applicant submits that it would take more than ordinary skill by TPOSA to derive Applicant's invention from the prior art at the time the invention was made.

Applicant believes the discussion in *In re Kotzab*, 55 U.S.P.Q. 2d 1313 at page 1316 (Fed. Cir. 2000), cited previously, is also relevant in this regard:

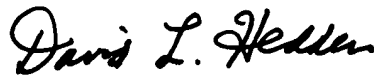
A critical step in analyzing the patentability of claims pursuant to section 103 (a) is casting the mind back to the time of invention, to consider the thinking of one of ordinary skill in the art, guided only by the prior art references and the then-accepted wisdom in the field. See *Dembiczak*, 175 F.3d at 999, 50 USPQ2d at 1617. Close adherence to this methodology is especially important in cases where the very ease with which the invention can be understood may prompt one "to fall victim to the insidious effect of a hindsight syndrome wherein that which only the invention taught is used against its teacher."⁴ *Id.* (quoting *W.L. Gore & Assocs., Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1553, 220 USPQ 303,313 (Fed. Cir. 1983).

⁴ Underlining added for emphasis.

Applicant submits that in this situation, there was no motivation to derive Applicant's invention or reasonable expectation that the benefits of using the claimed binder would result. Therefore, Applicant submits that, unless "hindsight" is used, his invention is not obvious.

Applicants submit that the application is now in condition for allowance and respectfully request a notice to this effect. If the Examiner believes further explanation of Applicant's position is needed, Applicant's attorney will discuss this matter over the telephone or visit the Examiner personally if this may be useful.

Respectfully submitted,

A handwritten signature in black ink that reads "David L. Hedden". The signature is written in a cursive, flowing style.

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